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Three Nice Labs, No Real Rats: A Review of Three Operant Laboratory Simulations

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The operant laboratory, once the foundation for a curriculum in behavior analysis, has become almost impossible to maintain because of costs, federal regulations, and other factors. Fortunately, over the years several computer simulations of animal labs have been developed. This paper describes, compares, and contrasts three simulations and concludes that in general, they are effective and offer an alternative to the real thing.

Key words: software, review, simulation, operant laboratory

Better teaching of behavior analysis, as advocated by Heward and Malott (1995), should provide students with more contingency-shaped behavior via operant laboratory experience and less rule-governed behavior via descriptions by professors or textbooks. Karp (1995) makes a case for the value of an operant animal laboratory, but recent advances in computer graphics have improved the quality of computer programs (e.g., Acker & Goldwater, 1991). They now provide a reasonable alternative to laboratory experiences.

Three current programs that simulate aspects of an operant laboratory environment are Behavior on a Disk, Sniffy the Virtual Rat, and The Box. Behavior on a Disk has tutorial features as well as simulations and covers topics beyond the operant chamber. Sniffy and The Box each limit themselves to operant behavior in the experimental chamber. Because a previous review covered Behavior on a Disk in its entirety (Mulick, 1992), this review will focus mostly on that program's operant chamber simulation—The Shaping Game. Table 1 shows the basic set-up information for the three programs.

THE SIMULATIONS

Behavior on a Disk

The Shaping Game. The student tries to shape a rat to bar press with a target force of 100 g. The student sees the rat on the screen and the rat presses a lever. How much force the rat exerted is displayed briefly after each bar press. The student must quickly decide whether or not to reinforce that particular approximation of the target force because the rat will press the bar again in 2 or 3 s. The simulation ends when the rat emits a 100-g bar press, or when satiation or extinction effects reduce responding to zero. (For a description of the development of Behavior on a Disk, see Shimoff and Catania, this issue.)

The Shaping Game teaches shaping in compressed time. Because the rat presses the bar 20 to 30 times per minute, the student does not have to wait long for things to happen. Students quickly learns that providing reinforcement after every bar press does not work; reinforcing every small increment will take a long time to produce the target behavior. Students also learn that they must drop the criterion for acceptable behavior when the rat has not produced anything close to the force for which they are waiting. If the student reinforces increments in force that are too small, the rat satiates and the game ends with the rat saying, "I'm full." Extinction is also programmed into the simulation. If eight to 10 consecutive responses go unreinforced, the game ends with the rat saying "I quit." These effects seem to combine for an efficient program.

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TABLE 1

System requirements and availability

	Behavior On a Disk	Sniffy the Virtual Rat	The Box
Computer platform	MS-DOS	Macintosh (MS-DOS in preparation)	MS-DOS
Version reviewed	2.0	4.5	2.01
Requirements	MS-DOS; printer optional	System 7.x or higher; color monitor preferred; minimum 1.5 Meg of free RAM	MS Windows; standard font modes; 4 MB of RAM; 4 MB of free hard drive space; MS compatible mouse; 640×480 VGA mode
Designers	Eliot Shimoff, Charles Catania, Byron Matthews	Tom Alloway, Lester Krames, Jeff Graham, Greg Wilson	Wayne Bartlett, Elson Bihm
Price (single user)	$13.50	$43.95	$89.00
Publisher	CMS Academic Software P.O. Box 1514 Columbia, MD 21044 E-mail: Shimoff @UMBC.edu (developer) Catania@ UMBC2. UMBC.edu (developer)	Brooks/Cole Publishing Co. 511 Forest Lodge Rd., Pacific Grove, CA 93950-5098 (408) 373-0728 (800) 487-3575 E-mail: Info@BrooksCole.com	Triad Soft P.O. Box 10162 Conway, AR 72033 E-mail: TriadSoft@AOL.com
ISBN	0-922077-20-7 (5.25-in. disk) 0-922077-21-5 (3.5-in. disk)	0-534-25836-0	

Other programs. Behavior on a Disk includes four other simulations that provide slightly different situations and decisions involved in shaping behavior. In The Threshold Game the student must decide how much weight to add to a weightlifting ape's barbells after a successful lift or failure on the previous trial. Goal Setting requires building a student's study time day by day, deciding how many more minutes to add to the target each day. The Distribution Game provides experience in reinforcing locations to increase the frequency of a virtual mouse preferring one spot along a line on the screen. Verbal Shaping requires the student to reinforce or ignore comments generated by a virtual client in an attempt to get the client to emit more optimistic statements.

Matching Cumulative Records is one of three programs aimed to help students become proficient in understanding cumulative records. The student uses the space bar as a bar press and tries to make a cumulative record similar to one generated by the program.

Sniffy the Virtual Rat

The student's job is to shape Sniffy the rat to press the lever. The student sees Sniffy in an operant chamber with three walls, a lever, a food receptacle, and a water tube. When one clicks the computer mouse with the screen pointer on the lever, the food magazine sounds a click and food appears in the food receptacle. Sniffy wanders around, occasionally scratching, sniff-

ing, and stretching—and eventually finds and eats the food. A real-time cumulative record displayed at the bottom of the screen shows Sniffy's bar presses and reinforcements received from those bar presses. This record can be printed out.

After the student has successfully shaped Sniffy to bar press, the cumulative record becomes much more interesting than watching Sniffy produce it. This is a nice feature that mirrors an actual operant lab. Although one could sit in front of the screen watching the rat for hours, one does not have to do so. Sniffy can be left working while the student does something else, confident that the bar-pressing behavior can be interpreted from the record produced.

Once Sniffy has been shaped to press the bar at a high enough frequency, the student can have the rat work through a number of simple fixed and variable interval and ratio schedules. One can save Sniffy's learned behavior as a file and start from that point the next time. If the student fails to save the performance of the virtual rat, the behavioral effects produced during the session are lost. The program comes with five files with Sniffy already at a particular stage of learning. This avoids the time required to start from scratch. The cumulative records for these files show the prior few minutes of data each time the student accesses the file.

The creators of Sniffy have programmed a number of variables to operate in conjunction and produce Sniffy's behavior. Six such features can be manipulated on a 5-point ordinal scale (e.g., low to high; slow to fast) through pull-down menus. These include variables such as the number of reinforcers required before a behavior's probability increases, the effectiveness of a single reinforcement, how often a reinforcer is delivered with Sniffy in a specific location before that sector of the chamber becomes attractive, and so forth. Over 20 other parameters (e.g., percentage of time Sniffy gets thirsty, how many responses until Sniffy behaves like he is a large fixed-ratio schedule) can be overriden or changed by entering and editing the actual program. The developers include technical information on how to edit the program, but caution that only experienced programmers will find the task to be easy.

The Box

The student's role can be either programmer of the operant chamber or learner in an operant chamber. As learner, the student is in the box and sees stimuli representing colored lights, levers, food, food receptacles, tokens, and point counters arranged on the screen. The student can respond freely to these box stimuli by pointing, clicking, and dragging the mouse to operate on the environment. Pointing to and clicking on a lever produces a lever press with an accompanying click sound. Responses to various stimuli are correlated with a variety of consequences (e.g., only a lever press during 10 s when the green light is on advances a counter by one).

As programmer, the student sets up the box and runs an experiment using humans as participants, deciding which stimuli to use and what the contingencies will be. Available demonstrations familiarize the student with the options that exist for stimuli. The student can program up to 25 different experimental conditions, and the program will tabulate the data. The program also produces cumulative records that can be viewed on the screen or printed out on a single sheet of paper.

SUGGESTIONS FOR IMPROVEMENT

Behavior on a Disk

The graphics and screen fonts used in this program show their relative antiquity. Upgrading these features would keep the program in tune with the technology existing in other software.

The printer software also appears to need updating. The program handles

TABLE 2

Program characteristics

	Behavior On a Disk	Sniffy the Virtual Rat	The Box
Interactive graphics	Yes	Yes	Yes
Quality of screen fonts and graphics	Acceptable; not high quality	High quality	High quality
Cumulative records	Not of shaping (cumulative records covered separately as tutorial and own set of simulations)	Yes (but shows only rat-produced reinforcements and not when shaper reinforced)	Yes (although both axes are stretch-to-fill instead of standard scale)
Print cumulative records	No (not of shaping)	Yes	Yes
Ease of use	Five times quicker for first-time use; excellent on-screen instructions available	Four times quicker for first-time use; detailed printable documentation	Four to five times slower for first-time use; manuals provided and need to be perused
Realism	Cartoon animals	3-D perspective drawing with shadow	3-D perspective with shadow and shading
Length of typical session after startup	6–10 min	20–120 min	1–2 min
Programmable	No	Yes	Yes
Set time for phase or session	No	No	Yes
Save files in progress	No	Yes	No
Sample files to run	No	Yes (5 files of Sniffy "trained")	Yes (22 various programs)
Does user learn what program tries to teach?	Probably	Probably	Probably

this problem well by having students respond to "no printer response." If a particular printer will not work with the system, at least the program does not crash because of it.

Although the student can choose four levels of The Shaping Game ranging from "easy" to "very hard," the program does not monitor one's performance in a way that provides any useful feedback as to the student's skill in shaping. Either the rat is shaped or it isn't. Even world class animal shapers will not succeed every time in the "very hard" condition. Providing more precise information on the shaper's behavior would allow students to see their own shaping skills develop. This would also allow an "all-time best" type file that may keep individuals playing a game beyond several successful completions.

Sniffy the Virtual Rat

The real-time aspects of Sniffy provides a realism that may stretch the endurance of some students, particularly those raised on a diet of video machines requiring high-frequency responses and high-density consequences.

The cumulative records do not show the scale of responses on the vertical axis or the minutes across the horizontal axis. All cumulative records drawn by the program represent a standard scale—the documentation explains that the up-and-down lines mark 5-min intervals—but what the standard involves should be made clear, on both axes. A fan that showed slopes for 0.25, 0.5, 1, and 3 responses per second was a standard part of each cumulative record Skinner presented

TABLE 3

Program Features

	The Shaping Game	Sniffy the Virtual Rat	The Box
Baseline frequencies	No	Yes (but data not accessible independent of cumulative record)	Yes (all defined behaviors recorded and accessible on screen)
Train by successive approximations?	Yes (time compressed)	Yes (real time)	No (lacks moment-by-moment decision feature)
Available consequences	Verbal feedback	Graphic of rat food	Graphic of cheese or seed; graphic of tokens; points on counter, lights, sound
Noncontingent reinforcement possible?	Yes	Yes	Yes
Establishing operation	No	Yes (water deprivation can be set on pull-down menu; food deprivation default is 24 hr)	No (not in program per se)
Discriminative stimuli available	No	No	Yes
Conditioned reinforcers or response definers	No	No	Yes
Aversive events	No	No	Yes (loss of points)
Extinction	Yes	Yes	Yes
Satiation	Yes	No (not in this version)	Yes (empirically possible)
Time-out	No	Yes	No
VR, VI, FR, FI	No	Yes	Yes
Mixed schedules	No	No	Yes
Multiple schedules	No	No	Yes
Concurrent schedules	No	No	Yes

(e.g., Skinner, 1959). These fans would greatly enhance the reading of Sniffy's cumulative records. Another helpful feature would be some signal, such as a dotted vertical line, on the cumulative record for phase changes.

Both screen and printed versions of the cumulative records are so small that adding the capability to print a table of the embedded data would be useful. Students could rechart the data and compare the cumulative records to other types of graphic display.

The Box

The descriptions of the various system components produce some difficulty in determining what to do first and where to go next. Such problems may reflect the addition of new features as the software evolved. The new user can easily be overwhelmed by too many options and no clear sequence. The documentation straightens these problems out to some extent, but ideally one could engage the program successfully without relying on the documentation.

SUMMARY

Each of the three programs contains nice features not found in the others. Tables 2 and 3 describe and compare many of the program characteristics and behavioral features. The price of Behavior on a Disk makes it very affordable to all. Sniffy the Virtual Rat seems more suited to students working through a few lengthy laboratory exercises. The Box allows students to de-

sign and run their own experiments with human participants. None of the three programs seem overpriced. Each of these programs can be a valuable tool for teachers of behavior analysis who want their students to learn about operant chamber processes, procedures, and concepts.

The main difference between the three programs seems to be that The Shaping Game and Sniffy the Virtual Rat produce simulations of what we know and have learned from the operant laboratory. These programs can help us to teach others what we already know. By contrast, The Box not only can help teach what is known but can also extend simulations as a new research tool. Programs such as this can help us quickly launch others into areas of discovery within the human operant realm. For example, one can adjust the incentive value by having the graphics used as consequences represent actual monetary amounts and then explore what kinds of cumulative records non-food-deprived college students generate on various schedules compared to published research with food-deprived organisms.

Animal research has been the foundation of behavior analysis. But because of space requirements, time, equipment, and cost, today few behavior analysts have the luxury of an animal laboratory. Fortunately, advancing simulations may make possible research tools of equal or greater power at far less cost.

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